

**2600-HZ E4D E5D SINGLE-FREQUENCY SIGNALING CIRCUIT
OUT-OF-SERVICE TESTS USING TESTING CIRCUIT SD-96519-01
OR SD-96519-02**

1. GENERAL

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1.01 This section describes methods of making out-of-service tests of 2600-Hz single-frequency signaling circuits per SD-99764-01, using testing circuit per SD-96519-01 or SD-96519-02. It also describes methods of making potentiometer adjustments to correct for changes in the characteristics of some circuit elements. If the requirements of this section cannot be met after readjustment of potentiometers or relays, the units should be returned to a repair center because of special techniques involved in testing and clearing trouble on some of the components.

Note: 303-Type relays shall be maintained in an upright position not less than 1 minute before beginning any tests.

1.02 This section is reissued for the following reasons:

- (a) To change Tests B, C, and G to Tests C, H, and J, respectively.
- (b) To add Tests B, G, and I for using the 4A signaling test set.
- (c) To delete references to the 13A TMS.
- (d) To delete references to brief tests.
- (e) To make minor changes as necessary.

This reissue affects the Equipment Test Lists.

1.03 The tests covered are:

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A. Operation of Transmitter CS, CS1, and HL Relays Using 2B Test Set: This test checks that the CS relay is properly following off-hook and on-hook loops signals. Also checked are the CS1 and HL relays.

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B. Operation of Transmitter CS, CS1, and HL Relays Using 4A Test Set: This test checks that the CS relay is properly following off-hook and on-hook loop signals. Also checked are the CS1 and HL relays.

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C. Transmitted Tone Level and RMB Check: This test checks the level of the transmitted single-frequency tone and the RMB relay.

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D. Test of 4-Wire Terminating Circuit, Gain of Receiver Voice Amplifier, and Blocking of Amplifier: The following features are checked: (1) transmission loss from 2-wire to 4-wire transmit and adjustment of TRNS potentiometer (2) transmission loss from 4-wire receive to 2-wire and adjustment of RCV potentiometer (3) transhybrid loss from 4-wire receive to 4-wire transmit (4) blocking of the voice amplifier by received signal frequency.

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E. Operate Sensitivity of Receiver Signaling Amplifier: This test checks the receiver sensitivity and describes its adjustment by means of the SS potentiometer.

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F. Timing of Receiver R and RG Relays Using 2B Test Set: This test checks the operate and release time of the R and RG relays and tells how to adjust the OT and RT potentiometers.

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G. Timing of Receiver R and RG Relays Using 4A Test Set: This test checks the operate and release time of the R and RG relays and tells how

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to adjust the OT and RT potentiometers.	20
H. Voice Amplifier Cutoff Transistor— Using 2B Test Set or VOM: This test checks that Q9 transistor is not conducting when there is no signal input.	21
I. Voice Amplifier Cutoff Transistor— Using 4A Test Set: This test checks the voice amplifier cut feature by pulsing SF tone through the LINE REC and measuring, at the EQPT REC, the initial portion of each pulse which is gated through the amplifier before the cut takes place.	22
J. Receiver Guard Action: This test checks the receiver guard circuit in limiting operation by voice signals. .	23
1.04 The J94021A (21A) transmission measuring set is referred to in this section as the TMS.	
1.05 The 2B signaling test set is referred to in this section as 2B test set.	
1.06 The 4A signaling test set is referred to in this section as 4A test set.	
1.07 The J98613AY test panel (SD-96519-01 or SD-96519-02) is referred to in this section as test circuit. KEYERS switch 1 and RECEIVER switch 2 on this panel are referred to as SW1 and SW2, respectively. Jacks and keys mentioned in this practice are part of the test circuit unless otherwise specified.	
1.08 Make percent break adjustments of the 2B test set slowly above 70 percent to prevent pulsing out incorrect values. Incorrect values will be obtained if the rate of vibration of the PERCENT BREAK meter pointer is not the same as that of the PULSES PER SECOND meter pointer. To restore correct percent break values, turn the ADJ % BK control counterclockwise until both pointers are vibrating at the same rate, then turn the control slowly clockwise until the desired percent break value is obtained. It may also be necessary to change the coarse ADJ % BK switch from S,	

M, or L setting to obtain the desired range on the PERCENT BREAK meter.

1.09 Lettered Steps: A letter *a, b, c*, etc, added to a step number in Part 3 or 4 of this section, indicates an action which may or may not be required depending on local conditions. The condition under which a lettered step or a series of lettered steps should be made is given in the ACTION column, and all steps governed by the same condition are designated by the same letter within a test. Where a condition does not apply, all steps designated by that letter should be omitted.

2. APPARATUS

2.01 The apparatus required for each test is shown in Table A. The details of each item are covered in the paragraph indicated by the number in parentheses.

2.02 Test circuit, J98613AY (SD-96519-01 or SD-96519-02) including folding test fixture, J98613AC.

2.03 The 2B test set, J64730B (SD-56134-02) W option or later, includes power cords.

2.04 The 4A test set, J94743A (SD-1C244-01) equipped with the E&M interface unit, J94743AD and SF interface unit, J94743AA.

2.05 The J94021A (21A) transmission measuring set (TMS).

2.06 KS-15410 VOM, equipped with testing leads.

2.07 Patching cord, P2A cord, 6 feet long, equipped with two 347A plugs (2P1D cord).

2.08 Patching cord, P2A cord, 6 feet long, equipped with two 347B plugs (2P3B cord).

2.09 Patching cord, P3E cord, 6 feet long, equipped with two 310 plugs (3P7A cord).

2.10 Patching cord, P3N cord, 6 feet long, equipped with a 241A plug and a 310 plug (3P17B cord).

2.11 Patching cord, 2 feet long, equipped with 8-pin (male) Jones plug KS-8585 L10 and 347 plug (P1P cord).

TABLE A

APPARATUS	TESTS									
	A	B	C	D	E	F	G	H	I	J
Test Circuit (2.02)	1	1	1	1	1	1	1	1	1	1
2B Test Set (2.03) or VOM (2.06)	1			1				1		
4A Test Set (2.04)		1			1				1	
TMS (2.05)	1	1	1		1	1	1			1
Cord (2.07)	1							1		
Cord (2.08)	1							1		
Cord (2.09)				1						
Cord (2.10)	1	1	1		1	1	1		1	1
Cord (2.11)	1									
Cord (2.12)				1						
258D (dummy) Plug	1							1		
Screwdriver, C	1	1	1	1	1	1	1	1	1	1
Tool (2.13)	1	1	1	1	1	1	1	1	1	1
Tool (2.14)						√	√			

√ As required

2.12 Testing cord, W2CF cord, one foot long, equipped with a 310 plug, a 360B tool, and a 360C tool (2W17D cord).

2.14 Blocking and insulating tools, as required. Use tools and apply, as covered in Section 069-020-801.

2.13 The 725A tool used to gain mechanical advantage in prying loose the signaling units from connectors.

3. PREPARATION

STEP	ACTION	VERIFICATION
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All Tests

- 1 At test circuit—
Set all keys to normal position before starting any tests.

Note: The twist keys in the test circuit are operated when the white line is in the vertical position and normal when the white line is in the horizontal position.

- 2 Obtain release of signaling circuit in accordance with approved procedures.
- 3 Using 725A tool as shown in Fig. 1 or 2, remove signaling unit from its in-service position.
- 4 Plug signaling unit into folding test fixture.

STEP	ACTION	VERIFICATION
5	Operate 2-WIRE key.	
6a	If test circuit is mounted in a REVERTIVE-TERMINATING bay, J98613AP— Operate CT key.	

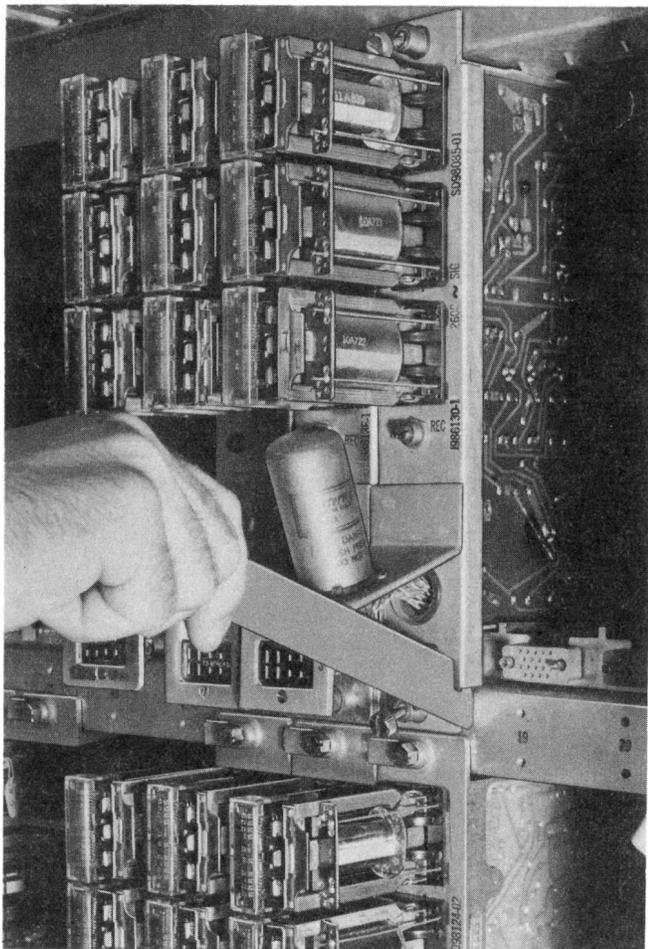


Fig. 1—Method of Removal of Fabricated Chassis

Tests A, B, C, D, E, F, G, and J

7 Using P3N cord, connect DET IN jack of TMS to SF SUP jack of test circuit.

TMS indicates between -14.6 and -16.1 dB.

Note: The TMS requires that the DET INPUT switch be set to the proper position for each measurement. The TMS indications called for as verification in this section are the combined total of the DET INPUT switch

STEP

ACTION

VERIFICATION

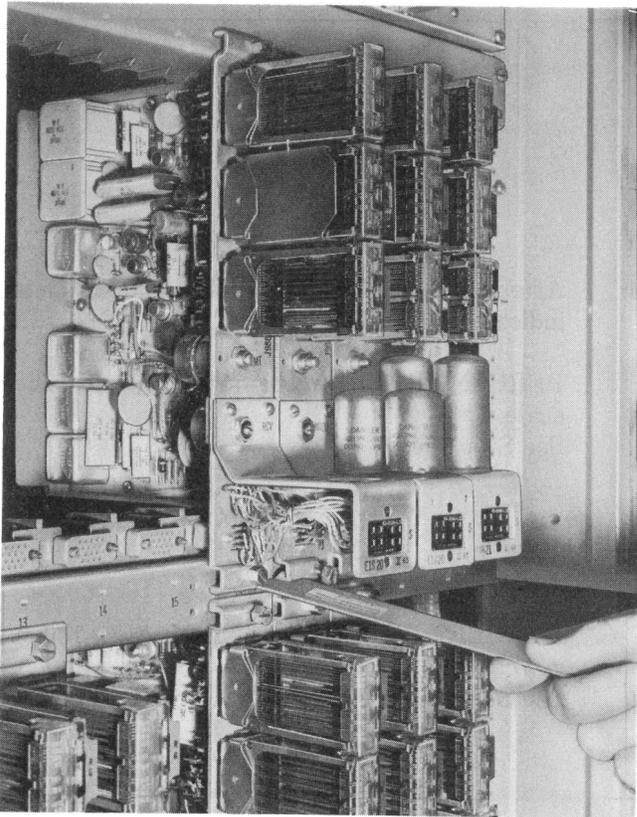


Fig. 2—Method of Removal of Die-Cast Chassis

- setting and the meter indication. The TMS should be correctly calibrated before using.
- 8 Disconnect plug from SF SUP jack, connect to AMP OUT jack of test circuit.
- 9 Set SW2 to position 2. TMS indicates 0 dB.
See Step 10b.
- 10b If requirement of Step 9 is not met—
Adjust gain control of MON amplifier to obtain 0 dB.
- 11 Disconnect plug from AMP OUT jack, connect to TMS jack of test circuit.

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STEP	ACTION	VERIFICATION
Tests A, F, and H		
12	Patch E and M jacks of test circuit to E and M jacks of 2B test set, using 2P3B and 2P1D cords.	
13	At 2B test set— Set all keys to normal position.	
14	Set SCALE SEL switch to PPS.	
15	Plug power cords of 2B test set into A and B jacks of test circuit.	After 1 minute, PULSES PER SECOND meter indicates other than 0.
16	Operate CONT PLS key to DIAL PLS.	PERCENT BREAK meter indicates 0 on <i>black</i> scale. See Step 17c.
17c	If requirement of Step 16 is not met— Adjust pointer adjustment screw of PERCENT BREAK meter to obtain 0.	
18	Insert 258D plug into P jack. <i>Note:</i> Repeat Steps 18 through 20 if test extends beyond 30 minutes.	PERCENT BREAK meter indicates 100 on <i>black</i> scale. See Step 19d.
19d	If requirement of Step 18 is not met— Unlock CAL % BK control, adjust control with screwdriver to obtain indication of 100, relock control taking care not to change 100 indication. <i>Note:</i> The proper performance of the tests covered in this section depends upon the correct pulse-per-second calibration and the range of the 2B test set. See Section 100-263-501 for calibration if accuracy is not known.	
20	Remove 258D plug.	
21	Restore CONT PLS key to normal.	
22	At 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter (0 to 20 scale).	
23	With coarse ADJ % BK switch on M— Adjust ADJ % BK control to 55 on <i>black</i> scale of PERCENT BREAK meter.	
24	At test circuit— Set SW1 to position 7.	

STEP	ACTION	VERIFICATION
25	At 2B test set— Operate TWD L key to OFF-HK.	
26	Operate PLS, MEAS % BK keys to LINE.	PERCENT BREAK meter indicates 55 on <i>black</i> scale. See Step 27e.
27e	If requirement of Step 26 is not met— Adjust M potentiometer of test circuit to 55 on <i>black</i> scale of PERCENT BREAK meter.	

Tests B, G, and I

- 28 Connect 4A test set to 110 volts ac, operate POWER switch to ON.
- 29 Equip 4A test set with E&M and SF interface units.
- 30 Using P3N cord, connect LINE/R jack of 4A test set to E jack and M jack of test circuit, with notched side of 241 plug toward E jack.
- 31 At 4A test set—
Set MS RANGE switch to 999.
- 32 Set FUNCTION switch to MSEC BK or MSEC MK.
- Note:* When verification calls for an indication in ms make or ms break, set the FUNCTION switch accordingly to obtain the proper indication.
- 33 Set SELECTOR switch to NORM.
- 34 Set READ switch to MSEC UPDATE.
- 35 Set RECEIVE, SEND switches to EM.
- 36 Set PULSE MODE switch to CONT.
- 37 At E&M interface unit—
Operate TWD LINE key to OFF HK.
TWD DROP key to ON HK.
- 38 Operate PULSE/MEAS key to LINE.
- 39 Set E&M/CX-S/R switch to E&M/CX.
- 40 Set PULSE PERIOD switch to 100.
- 41 Set PULSE WIDTH switch to 55.

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STEP	ACTION	VERIFICATION
	<i>Note:</i> The OPERATE-CLEAR key and the START-STOP key are operated when the lamp behind the key is lighted and released when the lamp is extinguished.	
42	Operate OPERATE-CLEAR key and START-STOP key.	
43	At test circuit— Set SW1 to position 7.	
44	At 4A test set— Operate GEN SUPV key to OFF HK.	4A display indicates 45 ms make. See Step 45e.
45e	If requirement of Step 44 is not met— Adjust M potentiometer of test circuit to obtain 45.	

4. METHOD

STEP	ACTION	VERIFICATION
A. Operation of Transmitter CS, CS1, and HL Relays Using 2B Test Set		
28	Adjust ADJ % BK control to 70 on <i>black</i> scale of PERCENT BREAK meter.	
29	Adjust ADJ PPS control until 21 on <i>black</i> scale of PERCENT BREAK meter is obtained.	PULSES PER SECOND meter indicates between 2.6 and 3.4 pps.
30	Using P1P cord, connect S socket of signaling unit to M1 jack of test circuit.	
31	At test circuit— Set SW1, SW2 to position 1.	
32	Operate E1D 1 and E1D 2 keys.	CS and CS1 relays pulse. PERCENT BREAK meter indicates between 20 and 24 on <i>black</i> scale. See Step 33f.
33f	If requirement of Step 32 is not met— Adjust CS1 potentiometer until 21 percent break is obtained.	
34g	If requirement of Step 33f is not met— Mechanical and electrical requirements of CS and CS1 relays on unit under test should be checked. Steps 22 and 28 through 32 should be repeated if any adjustments are made.	

STEP	ACTION	VERIFICATION
35	At 2B test set— Operate course ADJ % BK control to L.	
36	Adjust ADJ % BK control to 80 on <i>black</i> scale of PERCENT BREAK meter.	CS, CS1 relays pulse. HL relay operated. See Step 37h.
37h	If the requirement of Step 36 is not met— Mechanical and electrical requirements of CS and CS1 relays on unit under test should be checked. Steps 22 and 28 through 32, 35, and 36 should be repeated if any adjustments are made.	
38	Restore PLS key to normal.	CS, and HL relays operated; CS1 relay released.
39	Restore TWD L key to normal.	CS relay released; CS1 relay operated; HL relay released in less than 1 second. <i>Note:</i> In order to confirm verification, this step may be repeated by operating the TWD L key to OFF HK and then to normal.
40	Insert dummy plug into SF SUP jack.	
41	Set SW1 to position 2.	
42	Depress TMS A, TMS B keys simultaneously.	
43	At 2B test set— Operate TWD L key to OFF HK and PLS key to LINE.	
44	Adjust ADJ % BK control counterclockwise until 50 on <i>black</i> scale of PERCENT BREAK meter is obtained. <i>Note:</i> The indications in verification depend upon setting the TRNS potentiometer for a -16 dBm TLP. Perform Test E, Steps 12 through 16.	TMS indicates 10 to 20 dB and pointer pulsates at 3-pps rate. See Step 46i.
45	Adjust ADJ % BK control slowly clockwise until TMS stops pulsating.	PERCENT BREAK meter indicates less than 80 on <i>black</i> scale. See Step 46i.
46i	If the requirements of Steps 44 and 45 are not met— Cut circuit is not operating properly and unit must be returned to a repair center.	

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STEP	ACTION	VERIFICATION
47	Release TMS A and TMS B keys.	
48	Remove dummy plug from SF SUP jack.	
49	Restore E1D 1 and E1D 2 keys to normal.	
50	Remove test cord between S socket and M1 jack.	
51	At 2B test set— Restore keys to normal.	
52j	If no other tests are to be made— Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	
B. Operation of Transmitter CS, CS1, and HL Relays Using 4A Test Set		
46	Set PULSE PERIOD switch to 333.	
47	Set PULSE WIDTH switch to 70.	
48	Using P1P cord, connect S socket of SF unit to M1 jack of test circuit.	
49	At test circuit— Set SW1, SW2 to position 1	
50	Operate E1D1, E1D2 keys.	At SF unit— CS, CS1 relays pulse. 4A display indicates 66 to 89 ms make. See Step 51g.
51g	If requirement of Step 50 is not met— Adjust CS1 potentiometer of SF unit to obtain 70 ms make.	
52h	If requirement of Step 51g is not met— Check electrical and mechanical requirements of CS and CS1 relays, then, with PULSE PERIOD switch set to 100, repeat Steps 47 through 50 if any adjustments were made.	
53	At 4A test set— Set PULSE WIDTH switch to 267.	At SF unit— CS, CS1 relays pulse. HL relay operated. See Step 54i.
54i	If requirement of Step 53 is not met— Check electrical and mechanical requirements	

STEP	ACTION	VERIFICATION
	of CS and CS1 relays, then, with PULSE PERIOD switch set to 100, repeat Steps 47 through 50 and 53 if any adjustments were made.	
55	At 4A test set— Release OPERATE-CLEAR key.	At SF unit— CS, HL relays operated. CS1 relay released.
56	At 4A test set— Operate GEN SUPV key to ON HK.	CS relay released. CS1 relay operated. HL relay released in less than one second.
		Note: Operate GEN SUPV key to OFF HK then ON HK as necessary to confirm verification.
57	At test circuit— Insert dummy plug into SF SUP jack.	
58	Set SW1 to position 2.	
59	Simultaneously depress TMS A, TMS B keys.	
60	At 4A test set— Operate OPERATE-CLEAR key.	
61	Operate GEN SUPV key to OFF HK.	
62	Set PULSE WIDTH switch to 167.	TMS indicates 10 to 20 dB and pointer pulsates at 3-pps rate. See Step 64j.
	Note: The indications in Verification depend upon setting the TRNS potentiometer for a -16 dBm TLP. Perform Test E, Steps 12 through 16.	
63	At 4A test set— Raise PULSE WIDTH switch setting until TMS pointer stops pulsating.	4A display indicates less than 270 ms make. See Step 64j.
64j	If requirement of Step 62 or 63 is not met— Cut circuit is not operating properly and SF unit must be returned for repair.	
65	At test circuit— Release TMS A, TMS B keys.	
66	Remove dummy plug from SF SUP jack.	
67	Restore E1D 1, E1D 2 keys.	
68	Remove cord from S socket of SF unit and M1 jack of test circuit.	

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STEP	ACTION	VERIFICATION
69k	If no other tests are to be made— Restore all keys, remove all test cords, restore all circuits to normal.	
C. Transmitted Tone Level and RMB Check		
12	At test circuit— Operate E1D 1 and E1D 2 keys.	
13	Set SW1 to position 3, SW2 to position 1.	
14	Depress TMS A, TMS B keys simultaneously.	TMS indicates between -35 and -37 dB.
15	With TMS A and TMS B keys still pressed, set SW1 to position 4.	CS relay operated; CS1 relay released, HL relay operated. TMS indicates less power than -45 dBm.
RMB Check		
16	Manually operate relay RG.	CS relay released. TMS indicates less power than -45 dBm. When testing E4D— CS1 relay may momentarily operate but then releases. When testing E5D— CS1 relay operated.
17	Release relay RG.	
18	Release TMS A, TMS B keys.	
19	Block CS relay operated.	
20	Depress TMS A, TMS B keys.	
21	Set SW1 to position 3.	
22	Remove blocking tool from CS relay. <i>Note:</i> In order to confirm verification, this step may be repeated by manually operating the CS relay and then allowing it to release.	CS relay released; CS1 relay operated; HL relay released. Peak (kick) indication of TMS between -22 and -27 dB.
23	Release TMS A, TMS B keys.	
24	Restore E1D 1, E1D 2 keys to normal.	
25c	If no other tests are to be made— Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	

STEP	ACTION	VERIFICATION
D. Test of 4-Wire Terminating Circuit, Gain of Receiver Voice Amplifier, and Blocking of Amplifier		
<i>2-Wire to 4-Wire Loss</i>		
12	Operate 1000~A key.	
13	Set SW1 to position 5, SW2 to position 2.	
14	Verify that BAT LP key is normal.	
15	Operate LP CUR 1 key.	CS relay operated; CS1 relay released; HL relay operated.
16	Depress TMS A, TMS B keys simultaneously.	TMS indicates -16 dBm or as specified for transmit TLP as shown on circuit layout record minus 0.2 dB.
17	Adjust TRNS potentiometer of signaling unit fully counterclockwise.	TMS indicates -40 dBm or less power.
18	Adjust TRNS potentiometer fully clockwise.	TMS indicates -13 dBm or greater power.
19	Adjust TRNS potentiometer of signaling unit for specific 2-wire to 4-wire loss.	TMS indicates specified value shown for signaling unit on trunk layout record minus 0.2 dB.
20	Restore LP CUR 1 key.	Indication in Step 19 is removed, but reappears in about 1 second. See Step 22c.
21	Step 20 may be repeated until requirement is observed but first operate LP CUR 1 key.	
22c	If requirement of Step 20 is not met— The cut circuit is not operating properly and the unit under test must be returned to a repair center.	
23	Operate LP CUR 1 key.	
24	Release TMS A, TMS B keys.	
25	Restore 1000~A key to normal.	
<i>4-Wire to 2-Wire Loss</i>		
26	Operate 1000~B key.	TMS indicates -9 dBm or as specified for receive TLP as shown on circuit layout record plus 0.2 dB.

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STEP	ACTION	VERIFICATION
27d	If 2-wire loss is to be tested— Set RCV potentiometer fully counterclockwise.	TMS indicates -39 dBm or less power.
28d	Adjust RCV potentiometer to full clockwise position.	TMS indicates +1 dBm or greater power.
29d	Adjust RCV potentiometer to obtain exactly 0 dB reading on TMS.	

2-Wire Hybrid Loss

30d	Depress TMS A, TMS B keys simultaneously.	TMS indicates between -11 and -18 dB.
31d	Operate 2W TER key.	TMS indicates at least 15 dB less power than indicated in Step 30d.
32d	Restore 2W TER key to normal.	
33d	Release TMS A, TMS B keys.	
34d	Restore LP CUR 1, 1000~B keys.	
35d	Set SW1 to position 6, SW2 to position 4.	
36d	Set attenuator to 10.	TMS indicates 0 ± 0.2 dB. See Step 37e.
37e	If requirement of Step 36d is not met— Adjust gain potentiometer of TST amplifier to obtain 0 dB.	
38	Set SW1 to position 5, SW2 to position 3.	CS relay released. CS1 relay operated.
39	Operate LP CUR 1 key.	CS relay operated. CS1 relay released.

Electronic Cut

40	At SF unit— Block RG relay nonoperated.	
41	At test circuit— Set SW1 to position 6.	TMS indicates -40 dBm or less power.
42	Remove blocking tool from RG relay.	RG relay operated. When testing E4D— CS, CS1 relays released. When testing E5D— CS relay released. CS1 relay operated.

STEP	ACTION	VERIFICATION
		Note: Operation of RG relay depends upon sensitivity adjustment. If RG relay does not operate, perform Test F, then repeat Steps 35d through 42 of this test.
43	Restore LP CUR 1 key.	TMS indicates -45 dBm or less power.
44	Set SW1 to position 5, SW2 to position 2.	
45	Operate 1000~A key.	
46	Block RG relay nonoperated.	
47	Depress TMS A, TMS B keys simultaneously.	TMS indicates between -12 and -17 dB.
48	Set SW1 to position 6.	TMS indicates -40 dBm or less power. See Step 49f.
49f	If requirement of Step 48 is not met— The cut circuit is not operating properly and the unit under test must be returned to a repair center.	
50	Release TMS A, TMS B keys.	
51	Remove blocking tool from RG relay.	
52	Restore 1000~A key.	
53g	If Steps 27d through 34d were performed and requirements met— Set SW1 to position 5, SW2 to position 2.	RG relay released.
54g	Operate LP CUR 1 key.	CS relay operated.
55g	Operate 1000~B key.	TMS indicates 0 dB.
56g	Adjust RCV potentiometer of signaling unit for specific 4-wire to 2-wire loss.	TMS indicates specified value shown for signaling unit on trunk layout record plus 0.2 dB.
57g	Restore LP CUR 1, 1000~B keys.	
58g	Operate, then release LP CUR 2 key.	
59	Set SW2 to position 4.	
60h	If no other tests are to be made— Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	

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STEP	ACTION	VERIFICATION
E. Operate Sensitivity of Receiver Signaling Amplifier		
12	At test circuit— Set SW1 to position 6, SW2 to position 4.	
13	Set attenuator to 10.	TMS indicates 0 ± 0.2 dB. See Step 14C.
14c	If requirement of Step 13 is not met— Adjust gain control of TST amplifier for 0-dB indication on TMS.	
15	Set attenuator to 34.	
16	Set SW2 to position 3.	RG relay released. See step 17d.
17d	If RG relay operated— Adjust SS potentiometer of signaling unit slightly counterclockwise until RG relay releases.	RG relay released.
18	Set attenuator to 32.	RG relay operated. See Step 19e.
19e	If RG relay does not operate— Increase setting of SS potentiometer until RG relay just operates.	
20e	Repeat Steps 15 through 19e, until requirements of Steps 16 and 18 are met, starting with SW2 in position 4.	
21	Set Attenuator to 40.	RG relay released.
22	Set SW1 to position 5, SW2 to position 3.	RG relay remains released.
23	Operate LP CUR 1 key.	CS relay operated.
24	Set attenuator to 26.	
25	Set SW1 to position 6.	RG relay remains released.
26	Set attenuator to 20.	RG relay operated. CS relay released.
27	Set SW2 to position 1.	RG relay released.
28	Restore LP CUR 1 key.	
29f	If no other tests are to be made— Remove all cords, restore all keys to normal,	

STEP	ACTION	VERIFICATION
	return signaling unit to service or spare position.	
F. Timing of Receiver R and RG Relays Using 2B Test Set		
	<i>Note:</i> The requirements of this test depend upon the setting of the SS potentiometer. Perform Test F before beginning Test G.	
28	Set attenuator to 11.	
29	At 2B test set— Adjust ADJ % BK control to 33 on <i>black</i> scale of PERCENT BREAK meter.	
30	Turn ADJ PPS control counterclockwise to 3 pps on PULSES PER SECOND meter.	
31	At test circuit— Set SW1 to position 8, SW2 to position 3.	RG relay released, as indicated by PERCENT BREAK meter <i>red</i> scale indication of between 0 and 6. See Steps 37e through 42e.
32	Set SW1 to position 7.	
33	At 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
34	Adjust ADJ % BK control to 37 on <i>black</i> scale of PERCENT BREAK meter.	
35	Turn ADJ PPS control counterclockwise to 3 pps on PULSES PER SECOND meter.	
36	At test circuit— Set SW1 to position 8.	RG relay should pulse uniformly, as indicated by steady reading on PERCENT BREAK meter of 8 or more on <i>red</i> scale. See Steps 37e through 42e.
Adjust OT		
37e	If requirement of Step 31 or 36 is not met— Set SW1 to position 7.	
38e	At 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
39e	Adjust ADJ % BK control to 35 on <i>black</i> scale of PERCENT BREAK meter.	

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STEP	ACTION	VERIFICATION
40e	Turn ADJ PPS control counterclockwise to 3 pps on PULSES PER SECOND meter.	
41e	At test circuit— Set SW1 to position 8.	
42e	Adjust OT potentiometer of signaling unit until RG relay just pulses steadily.	PERCENT BREAK meter indicates 8 or more on <i>red</i> scale.

Adjust RT

43	At test circuit— Set SW1 to position 7.	
44	At 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
45	Adjust ADJ % BK control to 45 to <i>black</i> scale of PERCENT BREAK meter.	
46	At test circuit— Set SW1 to position 8.	PERCENT BREAK meter indicates 50 to 52 on <i>red</i> scale. See Step 47f.
47f	If requirement of Step 46 is not met— Turn RT potentiometer of signaling unit fully counterclockwise; then, rotate clockwise until 51 is obtained.	
48	Set SW1 to position 7.	
49	At 2B test set— Adjust ADJ % BK control to 70 on <i>black</i> scale of PERCENT BREAK meter.	
50	At test circuit— Set SW1 to position 8.	PERCENT BREAK meter indicates between 55 and 70 on <i>red</i> scale.
51	Set SW1 to position 7.	
52	At 2B test set— Adjust ADJ PPS control to 12 pps on PULSES PER SECOND meter.	
53	Adjust ADJ % BK control to minimum and then to 50 on <i>black</i> scale of PERCENT BREAK meter.	
54	Set SW1 to position 8.	Unit pulses uniformly with PERCENT BREAK meter indication between 54 and 64 on <i>red</i> scale.

STEP	ACTION	VERIFICATION
55	Set SW1 to position 7.	
56	At 2B test set— Adjust ADJ % BK control to 75 on <i>black</i> scale of PERCENT BREAK meter.	
57	Set SW1 to position 8.	Unit pulses uniformly with PERCENT BREAK meter indication between 59 and 72 on <i>red</i> scale.
<i>Rering Response</i>		
58	At 2B test set— Adjust ADJ PPS control to 10 pps on PULSES PER SECOND meter.	
59	Set SW1 to position 7.	
60	At 2B test set— Adjust ADJ % BK control to 55 on <i>black</i> scale of PERCENT BREAK meter.	
61	Adjust ADJ PPS control to 4 pps on PULSES PER SECOND meter.	PERCENT BREAK meter indicates 22 on <i>black</i> scale. See Step 62g.
62g	If requirement of Step 61 is not met— Adjust ADJ PPS control until 22 on <i>black</i> scale of PERCENT BREAK meter is obtained.	
63	At test circuit— Operate LP CUR 1 key.	
64	Set SW1 to position 8.	CS, RG relays pulse. PERCENT BREAK meter indicates between 20 and 30 on <i>red</i> scale.
65	Change attenuator in 2 dB steps from 5 to 17.	Indication in Step 64 should not vary more than ± 2 percent.
66	Set attenuator to 11.	
67	Set SW1 to position 7.	
68	At 2B test set— Adjust ADJ % BK control to 50 on <i>black</i> scale of PERCENT BREAK meter.	
9	Set SW1 to position 8.	PERCENT BREAK meter indication between 39 and 54 on <i>red</i> scale.
70	Set SW1 to position 7.	

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STEP	ACTION	VERIFICATION
71	Restore LP CUR 1 key to normal.	
72	At 2B test set— Restore all keys to normal.	
73h	If no other tests are to be made on this unit— Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	
G. Timing of R and RG Relays Using 4A Test Set		
<i>Note:</i> The requirements of this test depend upon the setting of the SS potentiometer. Perform Test E before beginning Test G.		
46	Set PULSE PERIOD switch to 333.	
47	Set PULSE WIDTH switch to 33.	
48	At test circuit— Set attenuator to 11.	
49	Set SW1 to position 8.	
50	Set SW2 to position 3.	At SF unit— RG relay released. At 4A test set— 4A display indicates 0 ms break. See Step 52f.
51	At 4A test set— Set PULSE WIDTH switch to 37.	RG relay pulses. 4A display indicates 27 ms break or more. See Step 52f.
52f	If requirements of Step 50 or 51 are not met— Set PULSE WIDTH switch to 35.	
53f	Adjust OT potentiometer of SF unit until 4A display indicates 27 ms break or more.	4A display indicates 27 ms break or more. RG relay pulses smoothly.
54	Set PULSE PERIOD switch to 100.	
55	Set PULSE WIDTH switch to 45.	4A display indicates 48 to 50 ms break. See Step 56g.
56g	If requirement of Step 55 is not met— Adjust RT potentiometer of SF unit fully counterclockwise then clockwise to obtain 51.	
57	Set PULSE WIDTH switch to 70.	4A display indicates 55 to 70 ms break.

STEP	ACTION	VERIFICATION
58	Set PULSE PERIOD switch to 83.	
59	Set PULSE WIDTH switch to 42.	4A display indicates 45 to 54 ms break.
60	Set PULSE WIDTH switch to 62.	4A display indicates 49 to 60 ms break.
61	Set PULSE PERIOD switch to 250.	
62	Set PULSE WIDTH switch to 138.	
63	At test circuit— Operate LP CUR 1 key	At SF unit— CS, RG relays pulse. 4A display indicates 120 to 180 ms break.
64	At test circuit— Change attenuator in 2-dB steps from 5 to 17.	4A display does not vary more than 10 ms from indication in Step 63.
65	Set attenuator to 11.	
66	At 4A test set— Set PULSE WIDTH switch to 125.	4A display indicates 100 to 140 ms break.
67	At test circuit— Restore LP CUR 1 key.	
68h	If no other tests are to be made— Restore all keys, remove all cords, restore all circuits to normal.	

H. Voice Amplifier Cutoff Transistor—Using 2B Test Set or VOM

28	At test circuit— Set SW 1 to position 5..	
29	Set SW 2 to position 1.	
30e	If using 2B test set— Using P3E cord, connect SENS 1 jack test circuit to VM jack of 2B test set.	
31e	At 2B test set— Set SCALE SEL switch to 20V.	Voltmeter of 2B test set indicates 0.7 volt or less.
32e	Remove cord from SENS 1, VM jacks.	
33e	Set SCALE SEL switch to PPS.	
34f	If using VOM— Connect the 310 plug of W2CF cord to SENS 1 jack of test circuit.	

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STEP	ACTION	VERIFICATION
35f	At VOM— Set selector switch to 3 VOLTS DC position.	
36f	Connect positive (+) lead of VOM to 360C (white) tool of W2CF cord.	
37f	Connect negative (-) lead of VOM to 360B (black) tool of W2CF cord.	VOM indicates 0.7 volt or less.
38f	Remove cord from SENS 1 jack and VOM.	
39g	If no other tests are to be made— Remove all cords, restore all keys, restore all circuits to normal.	

I. Voice Amplifier Cutoff Transistor—Using 4A Test Set

- 46 Equip 4A test set with SF interface unit.
- 47 Disconnect cord from DET IN jack of TMS, connect to FROM LINE jack of SF interface unit.
- 48 At 4A test set—
Operate PULSE/MEAS key of SF interface unit to LINE.
- 49 Operate TWD EQPT key of SF interface unit to MON.
- 50 Operate TWD LINE key of SF interface unit to MON.
- 51 Set NB-BB switch of SF interface unit to NB.
- 52 Operate TWD LINE key of E&M interface unit to OFF HK.
- 53 Set RECEIVE switch to SF.
- 54 Set PULSE PERIOD switch to 500.
- 55 Set PULSE WIDTH switch to 60.
- 56 At test circuit—
Set SW 1 to position 8.
- 57 Set SW 2 to position 3.
- 58 Set attenuator to 11.

STEP	ACTION	VERIFICATION
59	At 4A test set— Operate START-STOP key.	
60	Operate OPERATE-CLEAR key.	Display indicates 10 to 20 ms break. See Step 61f.
61f	If requirement of Step 60 is not met— Perform Test G, then repeat Test I.	
62g	If no other tests are to be made— Restore all keys, remove all cords, restore all circuits to normal.	
J. Receiver Guard Action		
12	At test circuit— Set SW1 to position 5, SW2 to position 6.	TMS indicates between -18.5 and -19.5 dB.
13	Set attenuator to 26.	
14	Set SW2 to position 5.	RG relay released.
15	Set SW1 to position 6.	RG relay remains released.
16	Set SW1 to position 5.	
17	Set attenuator to 21.	
18	Set SW1 to position 6.	RG relay operated.
19	Set SW1 to position 5.	RG relay released.
20	Operate LP CUR 1 key.	CS relay operated.
21	Set attenuator to 22.	
22	Set SW1 to position 6.	RG relay remains released.
23	Set attenuator to 16.	RG relay operated. CS relay released.
24	Set SW2 to position 4.	
25	Remove all cords, restore all keys to normal, return signaling unit to service or spare position.	